

Characterization of Bioactive Compounds from Tamarindus Indica for Potential Biological Properties

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Abstract—Tamarindus indica var. rhodocarpa (red tamarind) unripe fruits extract was subjected to GC/MS/MS analysis and identified 45 bioactive components by matching mass spectra with mass spectrum libraries. The major compounds present were 7, 9-ditert-butyl-1-oxaspiro[4.5]deca-6,9-diene-2,8-dione (77.22%) and Caryophyllene (16.01%). The former compound found to have antioxidant activity while the later reported to have antimicrobial and anticancer activity. Among the identified compounds most of the compounds were reported to have antimicrobial, anticancer and antioxidant activity. Profiling these phytochemicals may widen the industrial application of this fruit.

Key words: Biological Properties, GC/MS/MS Analysis, Industrial Application, Red Tamarind

I. INTRODUCTION

Plants possess bioactive compounds which find various scientific and commercial applications and either utilised directly or indirectly as natural plant products. Tamarindus indica L. (Red tamarind) belonging to the family Leguminosae, a multipurpose tropical tree used primarily for its fruits, timber, medicine, as food additive, in textile industries and as an economic source of protein [1] [2]. India is a largest producer of tamarind as it has become a staple ingredient in the cuisines around the world and used as medicine against various diseases for centuries. Being native to Africa, it is used in treating diseases such as fever, dysentery, jaundice, gonococci and gastrointestinal disorders [3][4][5]. Apart from the regular applications it has also been reported for other properties like hypolipemic and antioxidant [6], anti-inflammatory [7], antimicrobial [8], cytotoxic [4], against gastrointestinal spasms [4] and modifying the complement system [9]. The red tamarind is a rare mutant which contains rosy red pigments which are responsible for its red colour [10][11]. Because of the various evidences related to synthetic colours toxicological, adverse physiological, behavioural and harmful effects over the years, now the biocolourant is fetching attention and shifting of consumer need towards biocolours. Reference [12] suggested that red tamarind as a source of anthocyanin (biocolourant) has wide scope in food industry, pharmaceuticals, cosmetics and textile industries. So far many such investigations have been made with Tamarindus indica L., this study focused in determining the bioactive compounds present in red tamarind which holds limited information and thinly distributed in Tamil Nadu. Knowing the bioactive compounds present in this fruit will be an added advantage.

II. MATERIALS AND METHOD

The unripe fruits of red tamarind were collected from Pollachi, Coimbatore, Tamilnadu, India, situated between 10°39'12.0" N longitude and 077°02'03.6" E latitude. These

unripe fruits were brought to Bioprospecting laboratory, Institute of Forest Genetics and Tree Breeding, Coimbatore, for extraction of pigments. Extraction process involved maceration and overnight soaking of the unripe fruit in acidified methanol (0.01% HCl in methanol) under refrigerated condition. Repeated the process until faint coloured extract was obtained and pooled the filtrates. The solvent was then removed by evaporation under reduced pressure at 40 °C using rotary vacuum evaporator. The extract was filtered Varian Bond Elut C18 solid phase extraction column to remove impurities. 1µl of this solution was subjected to GC-MS-MS analysis.

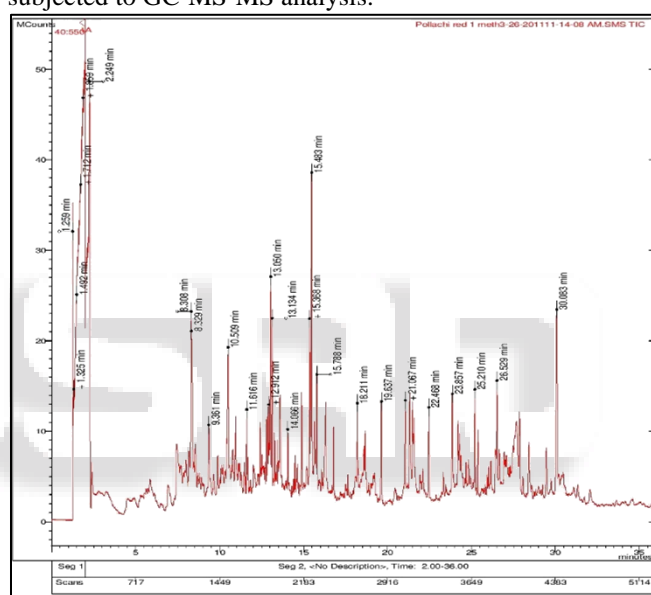


Fig. 1: GC/MS/MS chromatogram of methanol extract of Tamarindus indica var. rhodocarpa

A. GC/MS/MS analysis

Varian 4000 Ion trap GC/MS/MS with fused silica of 15m x 0.2 mm ID x 1µm capillary column at an initial temperature of 110 °C, maintained for 2 minutes. After 2minutes the oven temperature rose up to 280°C with a raise of 5 °C/min which is maintained for 9 minutes. The helium flow rate was set upto 1ml/min, injection port temperature at 250°C and ionisation voltage was 70eV. Injection port temperature was 250°C with the split mode as 10:1. The compounds present in the sample were identified by comparing the spectrum obtained (Fig 1.) through GC/MS/MS with the spectrum of components that are stored in the National Institute Standard and Technology (NIST) library.

III. RESULT AND DISCUSSION

The GCMS analysis of the methanol extract of red tamarind revealed the presence of numerous compounds (Table 1.) of which 7, 9 - ditert-butyl-1-oxaspiro [4.5]deca-6,9-diene-2,8-dione has the highest probability of 77.22% which is an antioxidant [13][14]. Caryophyllene a sesquiterpene recorded

the probability of 16.01%, reported to have numerous activities such as anticancer [15], anti-inflammatory [16], analgesic [17] and antimicrobial activities [18]. Aromadendrene (4.99 %) has antibacterial activity [19] and vitamin E [20], tonarol [21], peucenin [22], Longifolene v4 [23], valencene [24], Hexacosane [25], Hexadecanoic acid methyl ester [26], 1-Oxa-spiro[4.5]deca-6,9-diene-2,8-dione, 7,9-di-tert-butyl- [27], Hexatriacontane [28], 2,4-Bis(1,1-dimethylethyl) phenol [29] are reported as antioxidants. Epsilon cadinene has anti-proliferative activity [30]. Beta-selinene [31] has antibacterial activity, Alpha muurolene [32], Germacrene-D [33] and Alpha amorphene [34] has antifungal activity. Humulene [35], Caryophyllene [15], Sobrerol [36], 2-cyano-n-cyclohexylacetamide [37], 9,12-Octadecadienoic acid (Z,Z)-, methyl [38], Germanicol [39] and Tritetracontane [40] were reported to have anticancer activity. Most of the compounds present in this fruit reported to have anticancer, antimicrobial and antioxidant properties and hence it can be considered as a potential source in multiple industrial applications as natural colourant in food, cosmetics and textile industries. Alpha guaiene was used as fragrance and flavoring agent to impart spicy aromas and tastes [41], Erythritol Per-TMS as sugar alcohol/low calorie

sweetener [42], Docosanoic acid methyl ester as anti-foaming agent and smoothening agent in hair conditioner [43]. And now a days biocolorants made from renewable resources are gaining popularity due to consumer awareness and adverse effect of the synthetic dyes which cause severe health problems and are responsible for allergenic and intolerance reactions. The consumer preference for natural colourants is because of its nutrition, hygiene and pharmaceutical activities [44].

IV. CONCLUSION

The study revealed *Tamarindus indica* var. *Rhodocarpa* itself has a diversity of compounds with potent biological properties. The compounds identified in red tamarind unripe fruit found to have antioxidant, anticancer, antitumor, antimicrobial, anti-inflammatory, analgesic activity etc. Some of the compounds also found importance as a food additive, fragrance and flavouring agent and in the perfume industry. This cheap and renewable resource embedded with active compounds having desirable properties can be exploited in textile for colouration/ antimicrobial finishing of textiles, food colouration, cosmetics and pharmaceutical industries.

S. No	Retention time	Lead compound	Molecular formula	Molecular weight	%	HD	HA	RB	Log P	Biological properties
1	1.259	Sobrerol	C ₁₀ H ₁₈ O ₂	170	1.030	2	2	1	1.16	Antioxidant, anticancerous
2	1.492	Methyl 2-((1s,4s)-4-hydroxycyclopent-2-enyl) acetate	C ₈ H ₁₂ O ₃	156	6.394	1	3	3	0.08	-
3	1.565	1,5,9,13-Tétrathiacyclohexadécane-3,11-diol	C ₁₂ H ₂₄ O ₂ S ₄	328	4.400	2	2	0	1.53	-
4	1.803	2-cyano-n-cyclohexylacetamide	C ₉ H ₁₄ N ₂ O	166	2.656	1	3	3	0.49	Anticancer
5	1.922	Cyclohexanol,2-amino-,trans-	C ₆ H ₁₃ NO	115	1.776	3	2	0	0.16	-
6	1.989	Piperidinhydrochloride	C ₅ H ₁₂ ClN	121	1.220	-	-	-	-	-
7	2.013	Butyl piperidinosulfone	C ₉ H ₁₉ NO ₂ S	205	0.199	0	3	4	2.42	-
8	2.249	2,4-Dimethyl-2-decene	C ₁₂ H ₂₄	168	2.380	0	0	6	6.45	-
9	8.329	2,4-Bis (1,1-dimethylethyl) phenol	C ₁₄ H ₂₂ O	206	2.808	1	1	2	4.86	Antioxidant
10	10.509	Hexatriacontane	C ₃₆ H ₇₄	507	2.263	0	0	33	19.88	Antioxidant
11	13.050	1-Oxa-spiro[4.5]deca-6,9-diene-2,8-dione, 7,9-di-tert-butyl-	C ₁₇ H ₂₄ O ₃	276	4.253	0	3	2	3.08	Antioxidant
12	13.134	Hexadecanoic acid, methyl ester	C ₁₇ H ₃₄ O ₂	270	2.256	0	2	15	7.62	Antioxidant, anti-inflammatory
13	14.890	2H-Pyran, 2-(8-dodecyn-1-yloxy)tetrahydro-	C ₁₇ H ₃₀ O ₂	266	1.158	0	2	11	4.59	-
14	15.368	Octadecadienoic acid (Z,Z)-, methyl ester	C ₁₉ H ₃₄ O ₂	294	2.758	0	2	15	7.64	Anticancer, antitumour
15	15.483	2,4-Octadecadienal	C ₁₈ H ₃₂ O	264	7.015	0	1	14	7.43	-

16	15.788	Octadecanoic acid methyl ester	C ₁₉ H ₃₈ O ₂	298	1.398	0	2	17	8.68	-
17	18.211	Hexacosane	C ₂₆ H ₅₄	366	1.290	0	0	23	14.57	Antioxidant, antimicrobial
18	19.637	Heptacosane, 1-chloro-	C ₂₇ H ₅₅ Cl	415	1.432	0	0	25	14.78	-
19	19.830	Caryophyllene	C ₁₅ H ₂₄	204	16.01	0	0	0	6.78	Anticancer, antiinflammatory, analgesic activity, antimicrobial
20	19.830	Aromadendrene	C ₁₅ H ₂₄	204	4.99	0	0	0	4.7	Antibacterial
21	19.830	Humulene	C ₁₅ H ₂₄	204	2.85	0	0	0	7.03	Anticancer, antimicrobial
22	19.830	Leo caryophyllene	C ₁₅ H ₂₄	204	2.85	0	0	0	0	-
23	19.830	Valencene	C ₁₅ H ₂₄	204	1.35	0	0	1	6.28	Antimicrobial, antioxidant
24	19.830	Longifolene v4	C ₁₅ H ₂₄	204	1.30	0	0	0	5.2	Antioxidant, antibacterial
25	19.830	Epsilon cadinene	C ₁₅ H ₂₄	204	0.40	0	0	1	4.5	Antiproliferative
26	19.830	Alpha guaiene	C ₁₅ H ₂₄	204	0.38	0	0	1	4.6	Fragrance and flavoring agent to impart spicy aromas and tastes
27	19.830	Beta-selinene	C ₁₅ H ₂₄	204	0.35	0	0	1	5.4	Antibacterial
28	19.830	Thujopsene	C ₁₅ H ₂₄	204	0.35	0	0	0	4.8	-
29	19.830	Eremophilene	C ₁₅ H ₂₄	204	0.47	0	0	1	5.2	-
30	19.830	Alpha muurolene	C ₁₅ H ₂₄	204	0.34	0	0	1	4.1	Antifungal
31	19.830	Delta panasinsine	C ₁₅ H ₂₄	204	0.31	0	0	0	5.2	-
32	19.830	Alpha bisabolene	C ₁₅ H ₂₄	204	0.27	0	0	3	5.2	-
33	19.830	Germacrene-D	C ₁₅ H ₂₄	204	0.57	0	0	1	4.7	Antifungal
34	19.830	Alpha amorphene	C ₁₅ H ₂₄	204	0.23	0	0	1	4.1	Antifungal
35	19.830	Alpha neoclovene	C ₁₅ H ₂₄	204	-	0	0	0	4.9	Antimicrobial
36	19.830	Germanicol	C ₃₀ H ₅₀ O	426		1	1	0	9.4	Anticancer
37	19.830	7,9-ditert-butyl-1-oxaspiro[4.5]deca-6,9-diene-2,8-dione	C ₁₇ H ₂₄ O ₃	276	77.22	0	3	2	3.8	Antioxidant
38	19.830	Benzo[b]dihydropyran, 6-hydroxy-4,4,5,7,8-pentamethyl-	C ₁₄ H ₂₀ O ₂	220	0.21	1	2	0	3.9	-
39	19.830	Tonarol	C ₁₅ H ₂₄ O	220	0.13	1	1	2	5.32	Antioxidant
40	19.830	Erythritol Per-TMS	C ₁₆ H ₄₂ O ₄ S ₄	410	0.00	0	4	11	7.75	Sugar alcohol-Low calorie sweetener
41	19.830	Peucenin	C ₁₅ H ₁₆ O ₄	260	0.00	2	4	2	3.68	Antitumoral, Antioxidant
42	21.500	Docosanoic acid, methyl ester	C ₂₃ H ₄₆ O ₂	354	0.724	0	2	21	10.80	Anti-foaming agent, soothing agent in hair conditioner and lubricating oils
43	25.210	2-Hexyl-1-octanol	C ₁₄ H ₃₀ O	214	1.580	1	1	11	6.01	-
44	26.529	Tritetracontane	C ₄₃ H ₈₈	605	1.221	0	0	40	23.60	Antimicrobial, anticancer
45	30.083	Vitamin E	C ₂₉ H ₅₀ O ₂	430	4.308	1	2	12	11.90	Antioxidant

Table 1: GC/MS/MS analysis of methanol extract of *Tamarindus indica* var. *rhodocarpa*

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